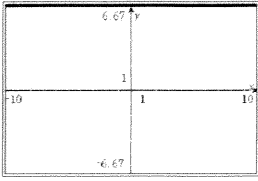


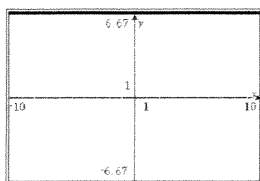
On page 1.1, graph the following functions and sketch each graph with a minimum of three points. Write the three coordinates in an x/y chart. Then, state why you chose those three points.

1.  $f(x) = x$



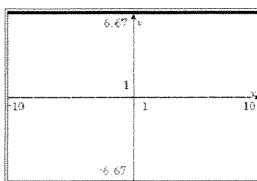
x	y
-1	-1
0	0
1	1

2.  $f(x) = x^2$



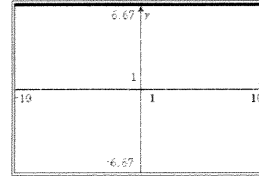
x	y
-1	1
0	0
1	1

3.  $f(x) = |x|$



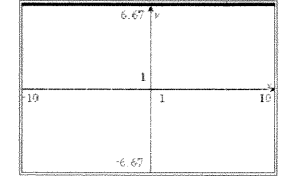
x	y
-1	1
0	0
1	1

4.  $f(x) = \sqrt{x}$



x	y
0	0
1	1
4	2

5.  $f(x) = x^3$



x	y
-1	-1
0	0
1	1

On pages 1.2–4.1, move the sliders and describe what is happening to the whole graph as they change.

1.2 description: \_\_\_\_\_

2.1 description: \_\_\_\_\_

3.1 description: \_\_\_\_\_

4.1 description: \_\_\_\_\_

What is happening to the parent functions x/y chart for each letter? Be specific!!

a: -# flip over x-axis, <1 wider, >1 skinnier

h: horizontal shift moves (L) or (R) opp of sign

k: vertical shift moves ↑ or ↓ same as sign

Write a rule for a, h and k.

a: stretch (fract), compress ( $a > 1$ ), flip ( $a \rightarrow -$ )

h: horizontal shift (opp of h)

k: vertical shift (same direction k)

On page 5.1, the parent function of  $f(x) = x^2$  is graphed. On  $f_2(x)$ , change the c-value to positive integers, negative integers and fractions and describe what it is doing to the graph. Look at the table and discuss what is changing from the parent function x/y chart.

What is happening to the parent function x/y chart for c? Be specific!!

c: \_\_\_\_\_

Write a rule for c.

c: \_\_\_\_\_

This is the standard form of a graph. All you need to do is change the exponent or grouping symbol for each graph. The important part is understanding what a, c, h and k do to the parent function.  $f(x) = a(c(x-h))^k$

So now with our rules, we can graph any function no matter what the parent function is. With your partner you will look at each of the functions and describe how the graphs are changing in reference to the parent function in terms of x and y.

1)  $f(x) = -(x-3)^2 + 2$  \_\_\_\_\_

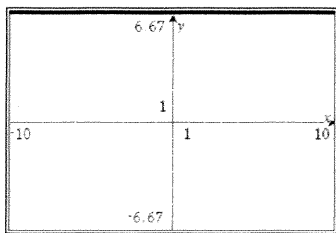
2)  $f(x) = 2(x+1)^3 - 1$  \_\_\_\_\_

3)  $f(x) = \sqrt{2(x-1)} + 5$  \_\_\_\_\_

4)  $f(x) = -3|-2(x+2)| - 2$  \_\_\_\_\_

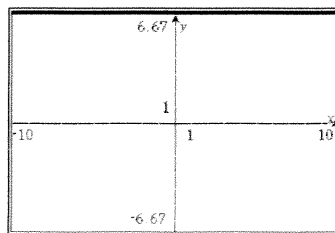
Now we are going to graph these by hand.

1)



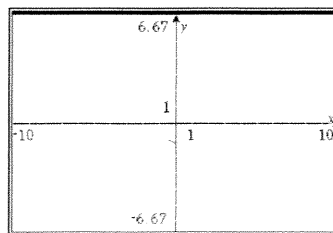
Parent x/y new x/y

2)



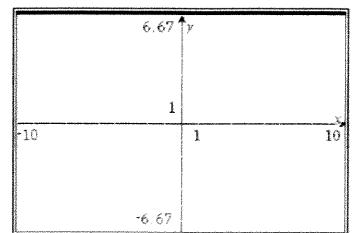
Parent x/y new x/y

3)



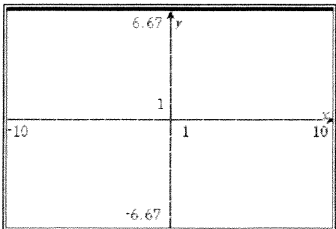
Parent x/y new x/y

4)

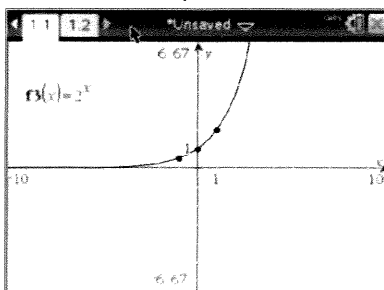


Parent x/y new x/y

By yourself, graph the following function:  $f(x) = 2(-(x+1))^2 - 3$

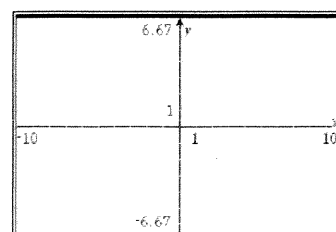


So, here is the equation of an exponential function with the parent functions x/y chart given. Graph the function with the transformations provided if the function follows  $f(x) = a \cdot b^{c(x-h)} + k$ .



x	y
-1	1/2
0	1
1	2

$$f(x) = 3 \cdot 2^{x+1} - 2$$



U32D

Parent Functions:  
Horizontal & Vertical Shifts WS

Name Key Per \_\_\_\_\_  
Date: \_\_\_\_\_

Sketch a graph of each function using the three critical points.

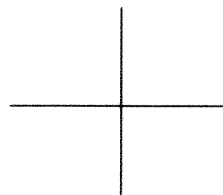
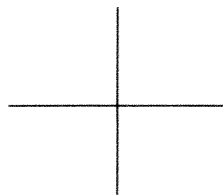
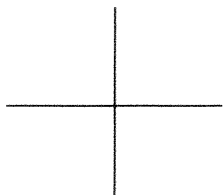
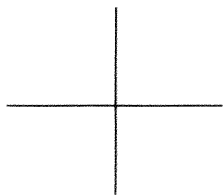
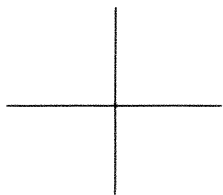
1.  $F(x) = x^2$

2.  $F(x) = |x|$

3.  $F(x) = \sqrt{x}$

4.  $F(x) = x^3$

5.  $F(x) = x$



Describe in words how the parent function is moving.

6.  $F(x) = (x-3)^2 - 2$  x's: +3 y's: -2

7.  $F(x) = |x+1| - 1$  -1 -1

8.  $F(x) = \sqrt{x-2} + 4$  +2 +4

9.  $F(x) = x^3 + 4$  +4

10.  $F(x) = x - 1$  -1

State the parent function and graph the three critical points. Then with another color move the points according to the transformation and graph it.

11.  $F(x) = (x+2)^3 - 1$

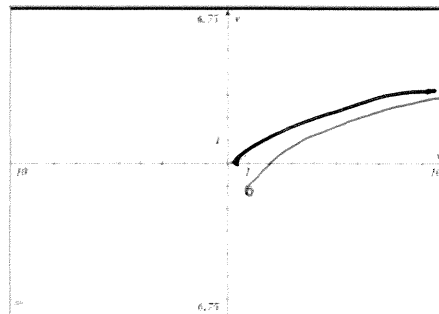
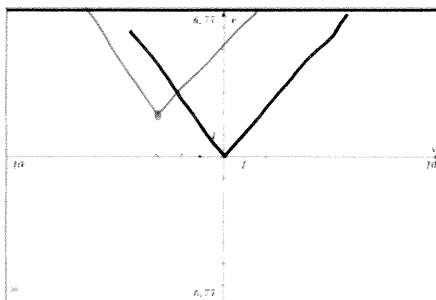
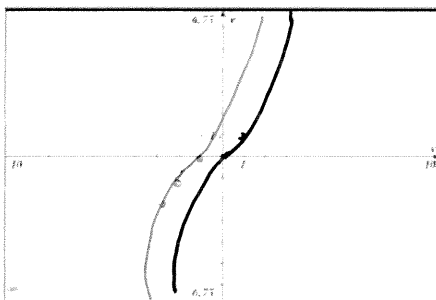
parent  $x^3$

12.  $F(x) = |x+3| + 2$

parent  $|x|$

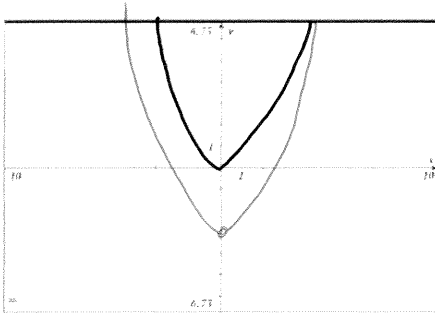
13.  $F(x) = \sqrt{x-1} - 1$

parent  $\sqrt{x}$



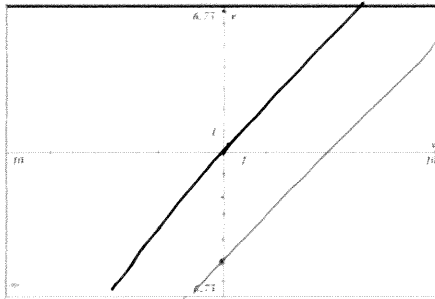
14.  $F(x) = x^2 - 3$

parent  $x^2$



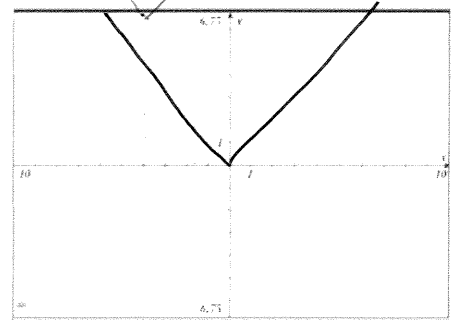
15.  $F(x) = x - 5$

parent  $x$



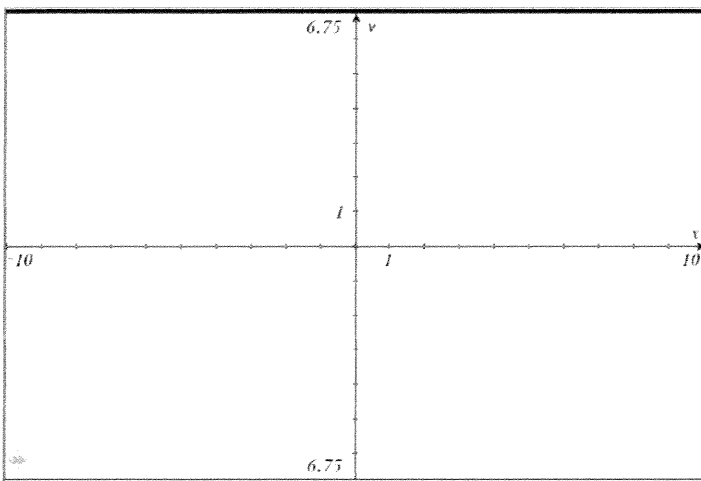
16.  $F(x) = |x + 4| + 6$

parent  $|x|$



Another parent function that we will see in a later chapter is  $f(x) = a^x$ , where  $a$  is a number. This is called an exponential function. The three critical points for this graph are  $(-1, \frac{1}{a})$ ,  $(0, 1)$  and  $(1, a)$ . For the parent function, the graph cannot pass the  $x$ -axis because there is a horizontal asymptote there. When the graph moves up or down the asymptote has to move the same amount. So, take a look at the following function and graph it according to the transformation rules we learned today.

17.  $F(x) = 2^{(x-2)} + 3$



$x$	$y$
-3	3.03
-1.2	3.11
0	3.25
1.2	3.57

$x$	$y$
-1	1.2
0	1
1	2
+2	+3

$x$	$y$
1	3.5
2	4
3	5

UBD3

Parent Functions:  
Reflections & Shrink/Stretch WS

Name Key Per \_\_\_\_\_  
Date: \_\_\_\_\_

Sketch a graph of each function using the three critical points.

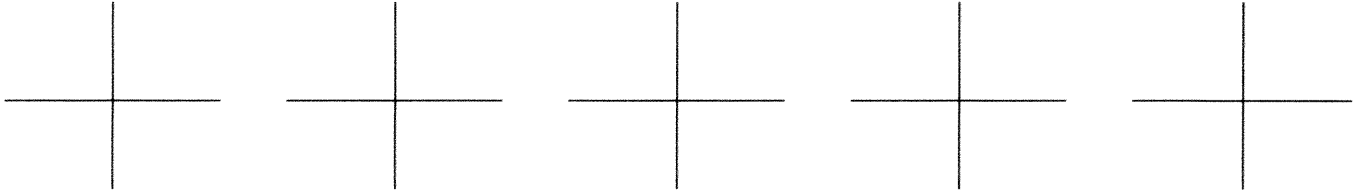
1.  $F(x) = |x|$

2.  $F(x) = \sqrt{x}$

3.  $F(x) = x^2$

4.  $F(x) = x$

5.  $F(x) = x^3$



Describe in words how the parent function is moving.

6.  $F(x) = 2(x-1)^2 + 3$  x's: +1 y's: x 2 + 3

7.  $F(x) = |2(x-1)| + 2$  x 1/2 + 1 + 2

8.  $F(x) = -2\sqrt{x+3} - 1$  - 3 x-2 -1

9.  $F(x) = -x^3 - 2$  x-1 -2

10.  $F(x) = x + 2$  + 2

State the parent function and graph the three critical points. Then with another color move the points according to the transformation and graph it.

11.  $F(x) = -2(x-3)^3 + 1$

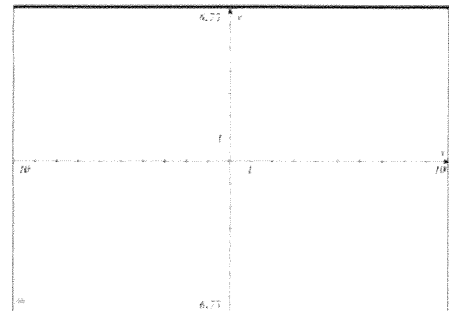
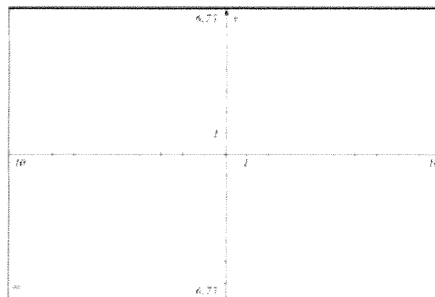
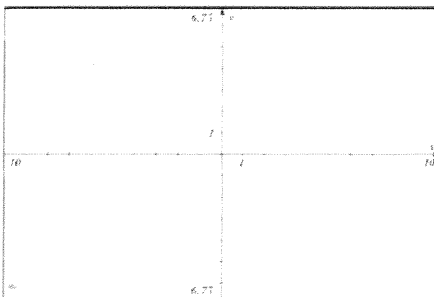
12.  $F(x) = \left|\frac{1}{2}(x+3)\right| - 1$

13.  $F(x) = \sqrt{-2(x+2)} - 3$

parent \_\_\_\_\_

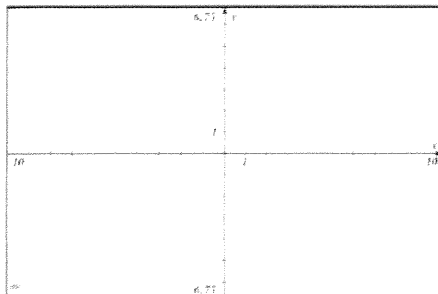
parent \_\_\_\_\_

parent \_\_\_\_\_



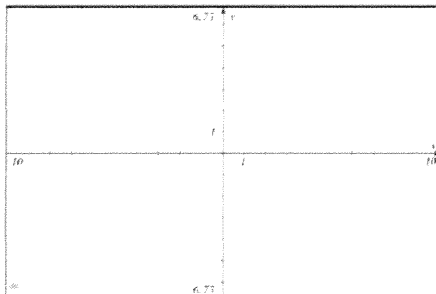
14.  $F(x) = \frac{1}{2}x^2 + 3$

parent \_\_\_\_\_



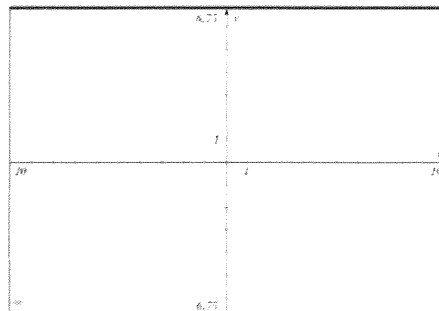
15.  $F(x) = x + 3$

parent \_\_\_\_\_



16.  $F(x) = -2|-(x + 3)| - 4$

parent \_\_\_\_\_



17. Make up your own function with transformations and then write out a description of how to graph it.

$f(x) =$  \_\_\_\_\_

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1. Describe the transformations to the parent function. Write the equation of the transformed function. What mathematical evidence allows you to conclude this?

Parent:  $f(x) = x^2$

x	-1	0	1
y	1	0	1

$x$ 's: +3 moves right 3

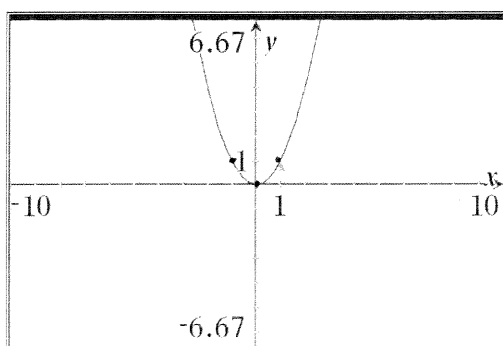
Transformation:

x	2	3	4
y	1	0	1

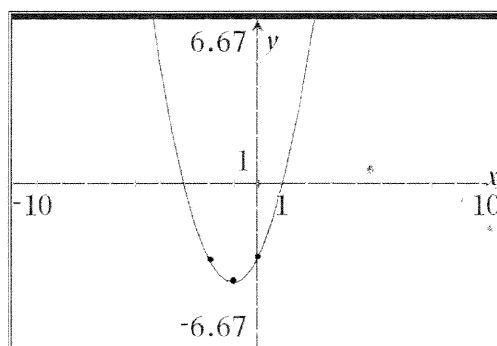
$$f(x) = (x-3)^2$$

2. Describe the transformations to the parent function. Write the equation of the transformed function. What mathematical evidence allows you to conclude this?

Parent function:



Transformation:



down: 4 left: 1

$$f(x) = (x+1)^2 - 4$$

3 critical pts shifted

3. Describe the transformations to the parent function. Write the equation of the transformed function. What mathematical evidence allows you to conclude this?

Parent:  $f(x) = \sqrt{x}$

x	0	1	4
y	0	1	2

Transformation:

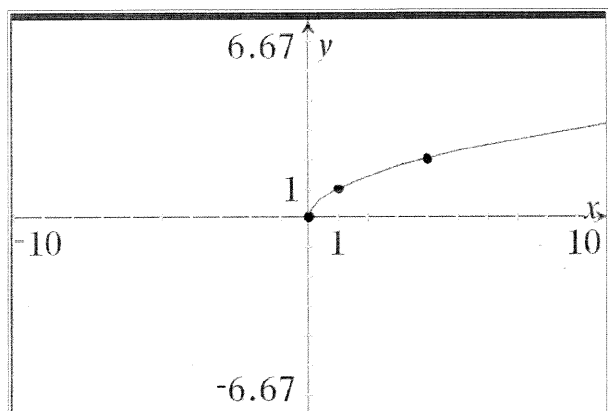
x	0	1	4
y	0	3	6

y's:  $\times 3$        $a = 3$

$$f(x) = 3\sqrt{x}$$

4. Describe the transformations to the parent function. Write the equation of the transformed function. What mathematical evidence allows you to conclude this?

Parent function:

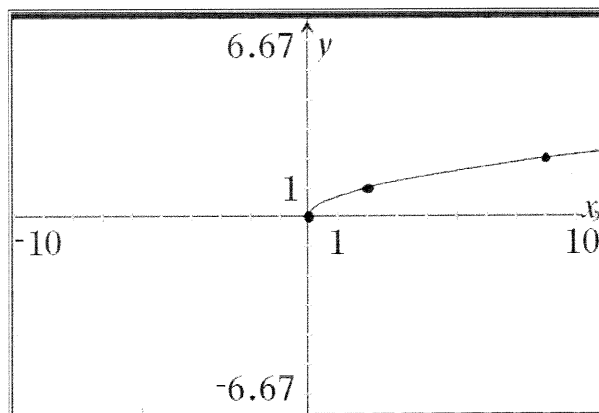


x	y
0	0
1	1
4	2

new

x	y
0	0
2	1
8	2

Transformation:



x's:  $\div 2$        $c = \frac{1}{2}$

$$y = \sqrt{\frac{1}{2}x}$$



5. Describe the transformations to the parent function. Write the equation of the transformed function.  
What mathematical evidence allows you to conclude this?

Parent:  $f(x) = |x|$

x	-1	0	1
y	1	0	1

$$y's: \cdot 3$$

$$a = 3$$

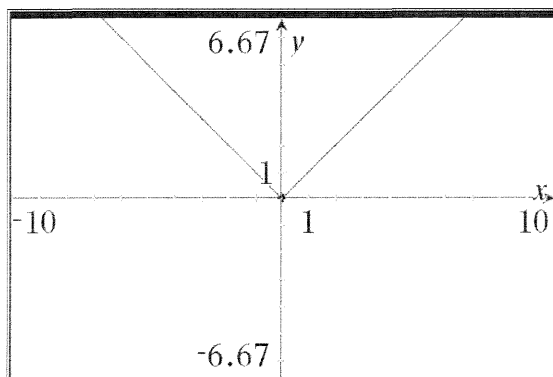
Transformation:

x	-1	0	1
y	3	0	3

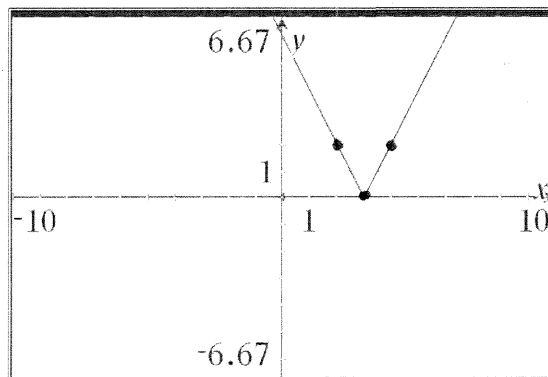
$$f(x) = 3|x|$$

6. Describe the transformations to the parent function. Write the equation of the transformed function.  
What mathematical evidence allows you to conclude this?

Parent function:



Transformation:



$$\begin{array}{c|c} x & y \\ \hline -1 & 1 \\ 0 & 0 \\ 1 & 1 \end{array} \quad \text{new}$$

$$\begin{array}{c|c} x & y \\ \hline 2 & 2 \\ 3 & 0 \\ 4 & 2 \end{array}$$

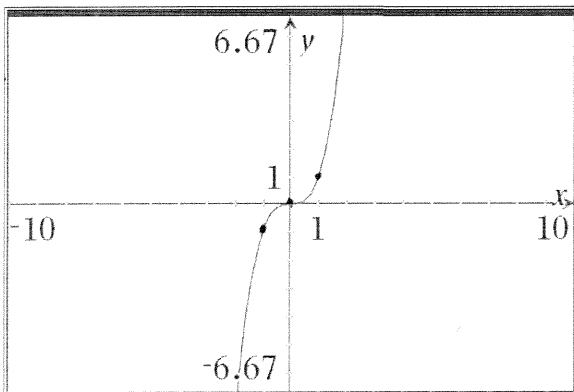
$$x's: +3$$

$$y's: \cdot 2$$

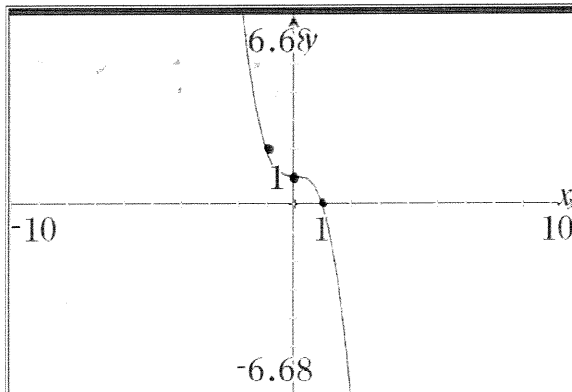
$$f(x) = 2|x - 3|$$

7. Describe the transformations to the parent function. Write the equation of the transformed function. What mathematical evidence allows you to conclude this?

Parent function:



Transformation:



new	
x/y	
-1	-1
0	0
1	1

y's:  $\cdot -1 + 1$

$$f(x) = -x^3 + 1$$

8. Write the function with the following transformations. How do you know your equation is right?

Parent:  $f(x) = x^3$

Reflection over the y-axis  $\cdot -1$  c

Horizontal stretch of 3  $\cdot \frac{1}{3}$  c

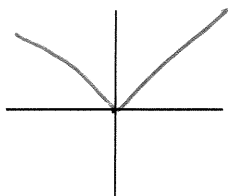
Shift left of 2  $+2$  h

Shift up of 3  $+3$  k

$$f(x) = \left(-\frac{1}{3}(x+2)\right)^3 + 3$$

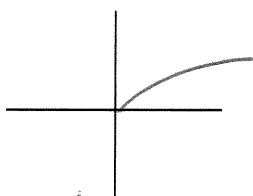
Sketch a graph of each function using the three critical points.

1.  $F(x) = |x|$



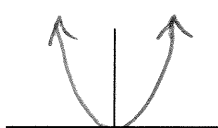
x	y
-1	1
0	0
1	1

2.  $F(x) = \sqrt{x}$



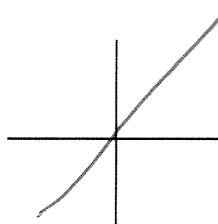
x	y
0	0
1	1
4	2

3.  $F(x) = x^2$



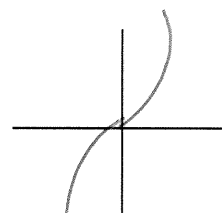
x	y
-1	1
0	0
1	1

4.  $F(x) = x$



x	y
-1	-1
0	0
1	1

5.  $F(x) = x^3$



x	y
-1	-1
0	0
1	1

Describe in words how the parent function is moving.

6.  $F(x) = 2(x-1)^2 + 3$  x's: +1

y's: x2 + 3

7.  $F(x) = |2(x-1)| + 2$

x's:  $\frac{1}{2} + 1$

y's: + 2

8.  $F(x) = -2\sqrt{x+3} - 1$

x's: -3

y's: -2 - 1

9.  $F(x) = -x^3 - 2$

x's:

y's: -1 - 2

10.  $F(x) = x + 2$

x's:

y's: + 2

State the parent function and graph the three critical points. Then with another color move the points according to the transformation and graph it.

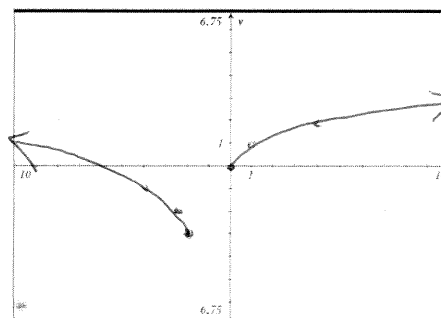
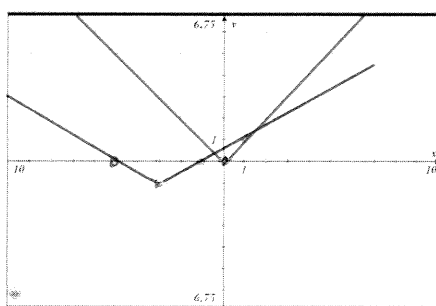
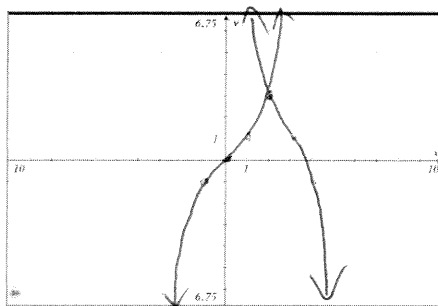
11.  $F(x) = -2(x-3)^3 + 1$

parent  $x^3$ 

12.  $F(x) = \left| \frac{1}{2}(x+3) \right| - 1$

parent  $|x|$ 

13.  $F(x) = \sqrt{-2(x+2)} - 3$

parent  $\sqrt{x}$ 

x	y
-1	-1
0	0
1	1

+3    -2 + 1

x	y
2	3
3	1
4	-1

x	y
-1	1
0	0
1	1

-2 - 3 - 1

x	y
-5	0
-3	-1
-1	0

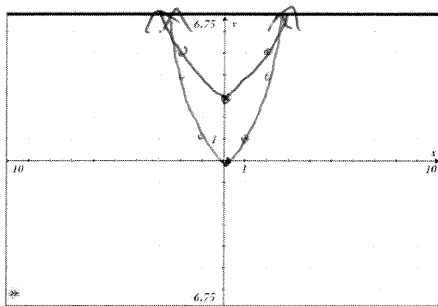
x	y
0	0
1	1
4	2

$\frac{1}{2}$  -2 - 3

x	y
-2	-3
-2.5	-2
-4	-1

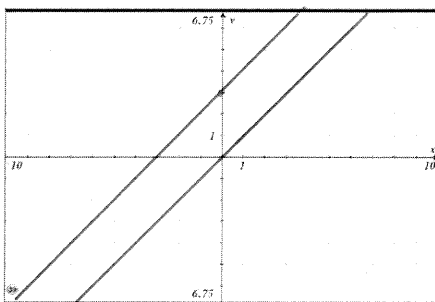
14.  $F(x) = \frac{1}{2}x^2 + 3$

parent  $x^2$



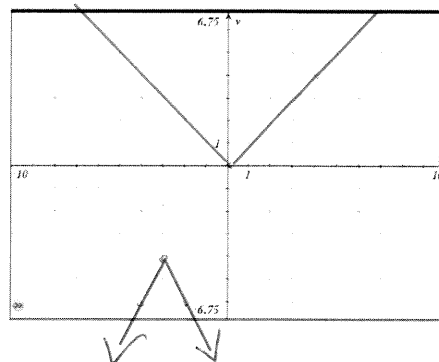
15.  $F(x) = x + 3$

parent  $x$



16.  $F(x) = -2|-(x + 3)| - 4$

parent  $|x|$



17. Make up your own function with translations and then write out a description on how to graph it.

$f(x) = -3\left(+\frac{1}{2}(x-2)\right)^2 - 4$

$x$ 's:  $x \cdot 2 + 2$      $y$ 's:  $x \cdot 3 - 4$

- A) Give the parent function.  
 B) Draw the general shape of the parent function.  
 C) Describe and write the transformations.  
 D) Describe how to graph.  
 E) Graph.

1.  $f(x) = 2|x - 2| + 3$

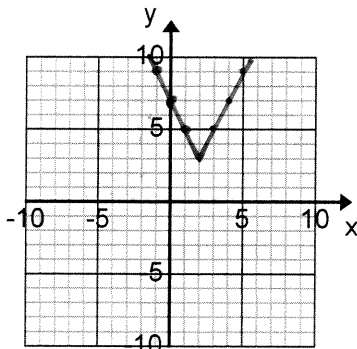
parent function  $|x|$ Up 3 DownLeft Right 2

Reflection

Vertical shrink ~~2~~Vertical stretch 2

Horizontal shrink

Horizontal stretch



2.  $f(x) = \left|\frac{1}{4}(x + 3)\right| - 4$

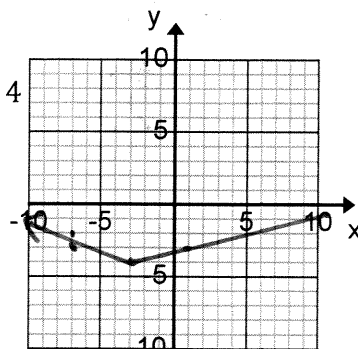
parent function  $|x|$ Up Down -4Left 3 Right

Reflection

Vertical shrink

Vertical stretch

Horizontal shrink

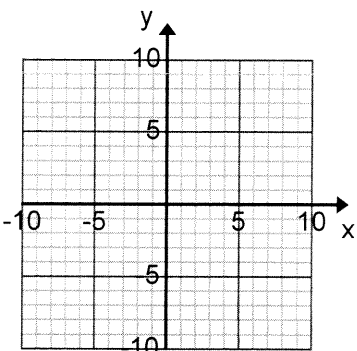
Horizontal stretch 4

3.  $f(x) = \frac{-2}{3}(x - 2)^3 - 3$

parent function  $x^3$ Up Down 3Left Right 2Reflection X-axisVertical shrink 2/3Vertical stretch ~~3/2~~

Horizontal shrink

Horizontal stretch

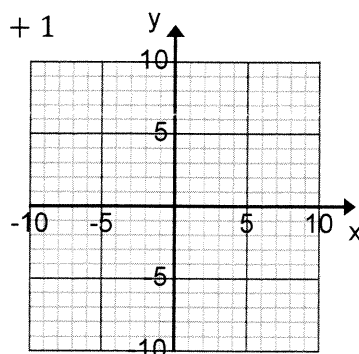


4.  $f(x) = -2(x - 2)^2 + 1$

parent function  $x^2$ Up 1 DownLeft Right 2Reflection X-axisVertical shrink ~~2~~Vertical stretch 2

Horizontal shrink

Horizontal stretch

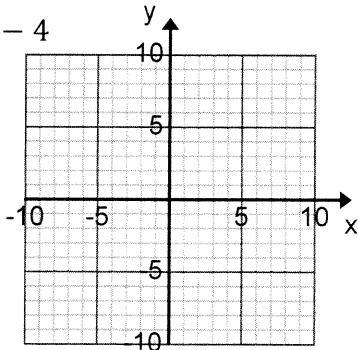


5.  $f(x) = 4(-(x - 3))^2 - 4$

parent function  $x^2$ Up Down 4Left Right 3Reflection y-axisVertical shrink ~~4~~Vertical stretch 4

Horizontal shrink

Horizontal stretch



6.  $f(x) = 3(x + 2)^3 + 1$

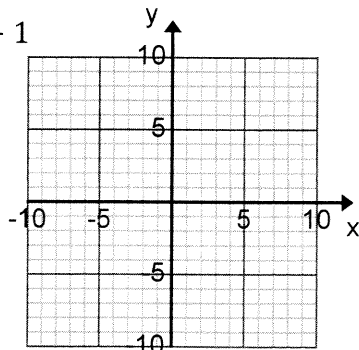
parent function  $x^3$ Up 1 DownLeft 2 Right

Reflection

Vertical shrink ~~3~~Vertical stretch 3

Horizontal shrink

Horizontal stretch



7.  $f(x) = -2\sqrt{x+1} + 3$

parent function  $\sqrt{x}$

Up 3 Down \_\_\_\_\_

Left 1 Right \_\_\_\_\_

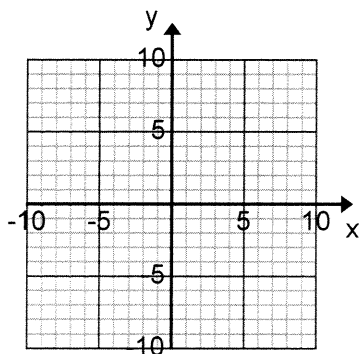
Reflection X-axis

Vertical shrink 2

Vertical stretch 2

Horizontal shrink \_\_\_\_\_

Horizontal stretch \_\_\_\_\_



8.  $f(x) = \frac{1}{4}\sqrt{2x} + 4$

parent function  $\sqrt{x}$

Up 4 Down \_\_\_\_\_

Left \_\_\_\_\_ Right \_\_\_\_\_

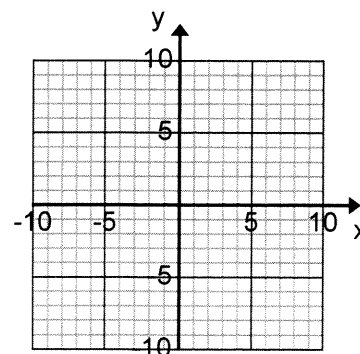
Reflection \_\_\_\_\_

Vertical shrink \_\_\_\_\_

Vertical stretch 1/4

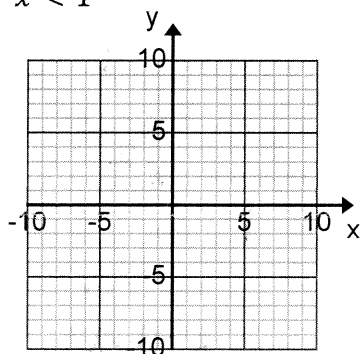
Horizontal shrink 1/2

Horizontal stretch \_\_\_\_\_

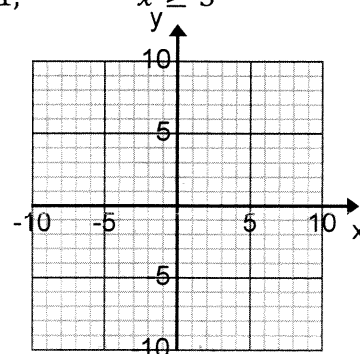


**Graph the piecewise function.**

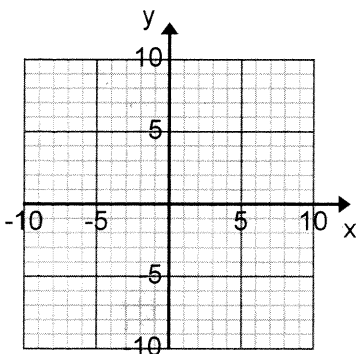
9.  $f(x) = \begin{cases} 3x - 2, & x \geq 1 \\ \sqrt{x+3} + 1, & x < 1 \end{cases}$



10.  $f(x) = \begin{cases} -2(x-2)^2 + 1, & x < 3 \\ -1, & x \geq 3 \end{cases}$



11.  $f(x) = \begin{cases} -2(x-3)^3 + 1, & x \leq 2 \\ -2x - 3, & x > 2 \end{cases}$



12.  $f(x) = \begin{cases} -|x+2| + 1, & x < -1 \\ -2, & -1 \leq x < 3 \\ x, & x \geq 3 \end{cases}$

